Sonel®

Cable & Pipe Locator

LKZ-1000

User Manual

Introduction

Purchase

Congratulations on your purchase of a LKZ-1000 instrument

Product identification

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "9 Safety Directions" for further information.Read carefully through the User Manual before you switch on the product.

The model and the serial number of your product are indicated on the type plate.Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or Sonel S.A. authorised service workshop.

Type: _____

Serial No.: _____

Symbols

The symbols used in this manual have the following meanings:

Type	Description
Danger	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
Warning	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
Caution	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage.
	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Validity of this manual

This manual applies to Sonel locator and transmitter instruments LKO-1000 and LKN-1000 and accessories. Differences between the various instruments and models are marked and described.

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1. General Information

1.1 How to use this manual

☞	It is recommended to set up the product while reading through this manual.
Index	The index is at the back of the manual.
Instrument label	On the Locator and Transmitter you will find a label that shows some important information by means of illustrations. You will find some of these illustrations in this manual too. This should help to get a clear connection between the instrument label and the informa-tion in this manual.

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Description

Locators are used to detect buried conductive services emitting an electromagnetic signal which is generated by a current passing through the service.

Transmitters are used to apply a distinct signal to conductive services, which may not radiate electromagnetic signals or may need to be traced for a specific purpose.The Transmitter is required to make a depth measurement.

The Locators and Transmitters described within this manual will greatly increase the detection process and help to reduce the dangers and costs associated with service strikes. But the very nature of electromagnetic location is dependent on the services being conductive (metallic) and radiating a signal as current flows through them.

It is important to remember that a Locator on its own will not detect all services and care should be taken when excavating. It is generally accepted that a safe system of work should be adopted which would include planning the work in advance, the use of utility maps, the use of Locators and Transmitters, and the use of safe digging practices.

Caution

The absence of a positive indication does not guarantee the non-existence of a service. Services without a detectable signal may be present.

The Locators can only locate non-metallic services such as plastic pipes, typically used by the water and gas utilities, with the use of appropriate accessories.

Precautions:
Always excavate with care.

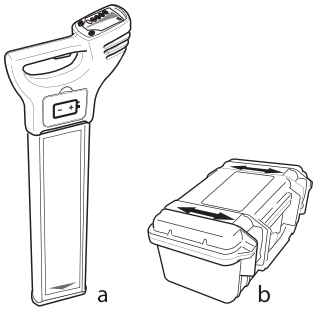
Accessories	Designed to increase the detection of services with no (or little) signals on them. Generally work in conjunction with the Locator and Transmitter.
Functional Check	Designed to demonstrate the equipment is working satisfactorily in between service intervals. Refer to "Appendix A Functional Checks" for more information.

1.3 Instruments and Accessories

General information

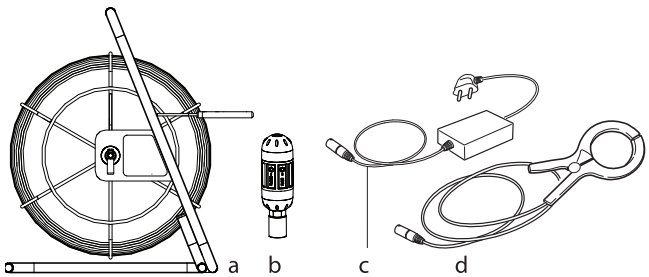
This is a collection of products used to locate buried metallic and nonmetallic services.

Instruments Overview



a) Locator LKO-1000 **(WMGBLKO1000)**
b) Transmitter **(WMGBLKN1000)**
c) Case L-6 **(WAFUTL6)**

Accessories Overview



a) Conductive Rod (non metallic service tracer):
-30m **(WAPRZPN30)**
-50m **(WAPRZPN50)**
-80m **(WAPRZPN80)**
b) Sonde NAD-1 **(WASONNAD1)**
c) Property Connection Set AS-1
Europe („French") standard **(WAADAAS1PL)**
Switzerland standard **(WAADAAS1CH)**
US standard **(WAADAAS1US)**
Australia standard **(WAADAAS1AU)**
d) Signal Clamp N-2 **(WACEGN2)**

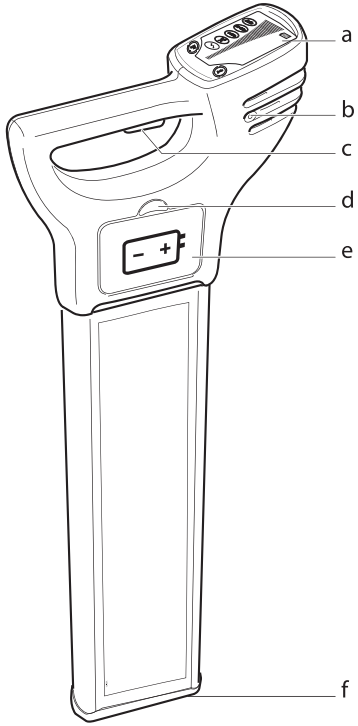
2. How to Use the Locator

2.1 General Information

Operating Modes	• Passive modes (Power and Radio) • Active modes (8kHz and 33kHz) • Auto mode (Combined Power and Radio modes)
Electromagnetic signals	An electromagnetic signal radiates from buried conductive services as an electrical current flows through them. The Locator processes these signals and displays their presence.
Passive signals	Some signals are already present on buried services and can be readily detected by the Locator. We call these passive signals. These signals are generated by power distribution systems and radio transmitters.
Active tracing	Some conductive services do not emit passive signals. These services may be traced by applying a signal to the service by using a transmitter.
Depth indication	Depth indication is only available with the Locator when used in conjunction with the Transmitter or Sonde. The displayed depth is to the centre of the service or to the Sonde.
Hazard zone	Provides an additional alarm, indicating the close proximity of a service emitting a Power, 8kHz or 33kHz signal.
Peak hold	Assists in pinpointing a service by displaying the peak reading for a short period of time.

2.2 LKO-1000 Locator Overview

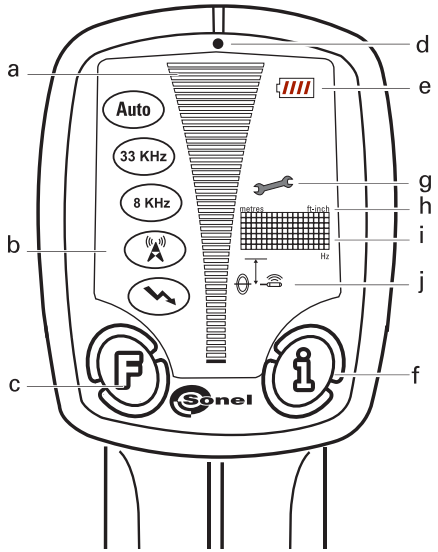
Locator main parts



a) Display Panel
Contains the operational controls.
b) Speakers (mounted internally left and right)
Active at power on and when a signal is detected.
c) On/Off Trigger
Press and hold the trigger to activate the Locator.
Release the trigger to deactivate.
d) Battery Hatch Release
Pressing the yellow release button unlocks the battery hatch allowing access to the battery compartment.
e) Battery Compartment
6 x LR6 (AA) alkaline batteries are used. Replace all batteries when indicated.
f) Case Foot

The case foot can be replaced if it is worn. Contact your agency or Sonel S.A. authorised service workshop.

Display panel overview



a) Signal Strength Indicator
Indicates the response of the Locator to a signal (service).

b) Mode Indicators
Displays the selected mode: Power, Radio, 8kHz, 33kHz, Auto (as shown, from bottom to top).

c) Function Button
Selects operating mode.

d) Light Sensor
Automatically switches the displays backlight on or off to suit light conditions.

e) Battery Indicator
Indicates the battery condition. Segment illumina-tion decreases as battery condition declines. Replace the batteries when the battery indicator is empty.

f) „i" Button
Used to access the user settings and to provide a depth readout.

g) Wrench
Indicates the Locator requires periodic service or the unit is faulty (Balfour Beatty customised locators will not operate if the wrench icon is displayed.

h) Measurement Unit
Indicates depth indication is in metric or feet and inches.

i) Display Readout
Alpha numeric matrix indicates system set up and depth indication.

j) Depth Mode Indicators
Indicates a depth reading to a service or a Sonde. Service depth icon used to indicate 'Hazard Zone' status.

2.3 Locator Setup and Information

The Locators offer a range of settings which the operator can adjust to their own preference. It also displays additional service and contact information as detailed

Setting	Description
EST	Performs a function check on the locators hardware and software, displaying PAS if the Locator is within predefined tolerance or ERR if the locator it is not.
H.Z	Switches ‘Hazard Zone’ on or off (Hazard Zone cannot be disabled oncustomised locators).
VOL	Adjust volume level (0 - 10).
HLD	Adjust peak hold duration (0 - 5 seconds).
SSI	Displays a numeric signal strength indicator.
CST	Adjusts display’s contrast (0 - 15).
M/I	Displays unit of measurement.
CAL	Displays the next service date DD/MM/YY.
TEL	Displays supplier/company telephone number.
I.D.	Displays the operator’s name.
PWR	Displays the power mode regional setting. Refer to "Appendix B World Frequency Zones" for more information.
SR#	Displays unit serial number.
VER	Displays software version
CLK	Displays the date held within the locators memory. Format DD/MM/YY/HH/MM/SS

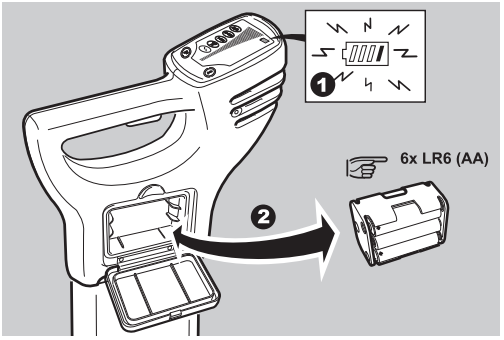
Accessing and adjusting the settings

1. Switch the Locator on.
2. Ensure the Locator is in Power mode.If required, press Function Button to select mode.
3. Depress i Button for 2 seconds. The user settings will be displayed in the display readout.
4. Press Function Button to toggle through to desired setting.
5. Press i Button to select the setting.
6. Press Function Button to activate/adjust.
7. Press i Button to store and exit.

Danger

The Locator may fail to detect electrical services in Power mode if an incorrect power setting is used.
Precautions:
Before use, verify the Locator is setup to be compatible with mains frequency supply in your country. Options are 50 or 60Hz. Refer to "Appendix B World Frequency Zones" for more information.
Contact your agency or Sonel S.A. authorised service workshop if your unit is incorrectly configured for your region.

Changing the battery



1. Replace the batteries when the battery status indicator is empty.
2. Press the yellow release button to unlock the Battery Hatch. Remove the battery holder from the Locator.
3. Replace all batteries with six new, LR6(AA) batteries.

Alkaline batteries should be used.

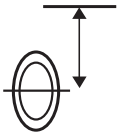
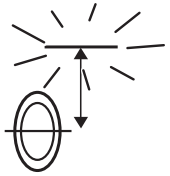
2.4 Hazard Zone

Description

Provides an additional warning to the close proximity of buried services and functions in the following modes:

- Power
- 8 kHz
- 33 kHz
- Auto mode (Power mode only)

Hazard zone status indicators

Status Indicator	Description
	Hazard zone is switched on.
	Hazard zone on and is alarming.
	Hazard zone is switched off. Note - Hazard Zone cannot be disabled on Balfour Beattycustomised locators.

Caution

The absence of a positive indication does not guarantee the non-existence of a service. Services without a detectable signal may be present. The Locators can only locate non-metallic services such as plastic pipes, typically used by the water and gas utilities, with the use of appropriate accessories.
Precautions:
Always excavate with care.

2.5 How to Locate a Service

Start up test

The following test sequence will take place every time the Locator is activated.

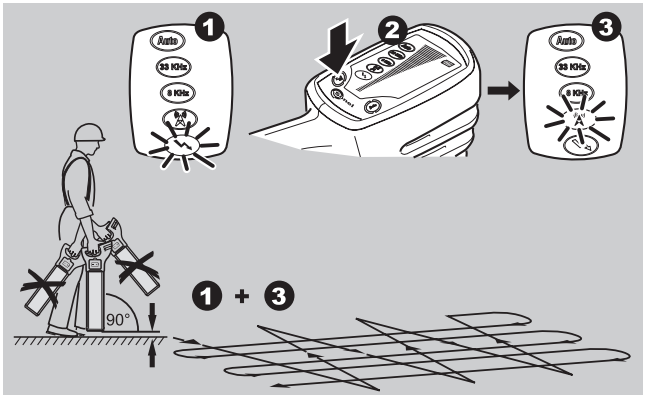
On test	Test pattern	Info on label
Audio Output	On throughout test sequence	
Signal Strength indicator	Scrolls through in sequence once	
Mode indicators	Briefly illuminated	
Battery indicator	On throughout	
Measurement unit, display readout, depth mode indicator	Briefly illuminated	

The unit will then go into Power mode maximum sensitivity.

Locating process

The locating process is split into three steps:
- Sweep Search
- Pinpointing the service
- Direction of the service

Sweep Search



The unit will automatically select Power mode and maximum sensitivity

Auto mode combines the benefit of simultaneous detection in Power and Radio modes and helps to confirm the presence of services upon initial site occupation. Improved defi-nition of the service will be provided by single mode operation.

1. Define the area to be excavated.
2. In Power mode cross the site from left to right keeping the Locator LKO-1000 upright, taking care not to swing the unit. Turn through 90 degrees and repeat.

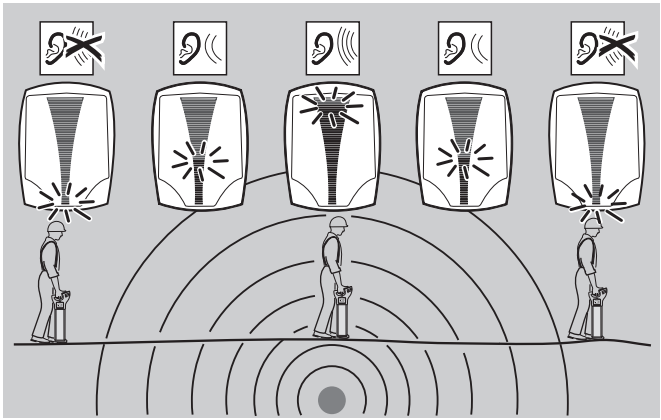
   ☞ Ensure that the Locator is held in an upright position and close to the ground.
3. Continue the sweep until either a signal is located or you are satisfied that the area has been adequately tested.

   ☞ In the presence of a service emitting a traceable signal a tone will be emitted and the signal strength indicator will rise and fall as you pass over it.
4. Repeat the Sweep Search process in Radio mode.

   ☞ The Sweep Search must be conducted in Power and Radio modes as a minimum, as not all services (including some electrical ones) emit a power signal. These services may be found using Radio mode or active modes.

Hazard zone can be operated in Power, 8kHz, 33kHz and Auto modes and provides an additional alarm to the presence of buried services which may be within close proximity.

Pinpointing the service

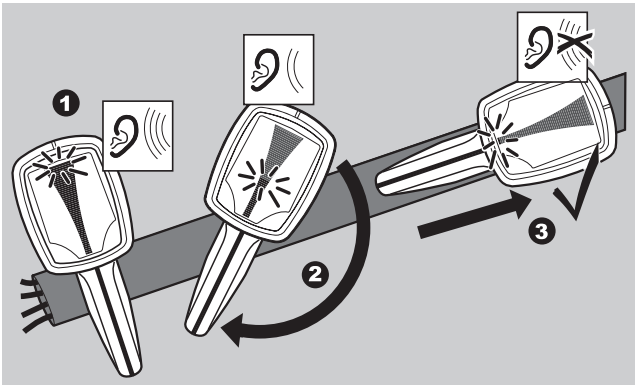


Retrace your steps to the area where the highest signal reading (peak response) was obtained. The service is directly below the Locator when the signal strength indicator is at its maximum. The audio output will automatically adjust to facilitate pinpointing over the service, and automati-cally reset when the signal strength indicator drops to its minimum position.

- Always use chalk or paint to mark services, never pegs.
- The signal strength indicator does not indicate the size, depth or type of a service.

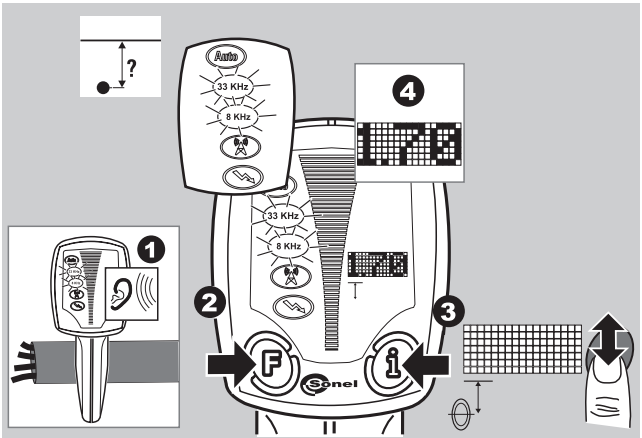
Peak hold
When activated peak hold will show the highest peak reading obtained during the pinpoint process. The displayed reading can be adjusted between 0 to 5 seconds.

Detecting direction of the service



1. Position the Locator directly over the service.
2. Rotate the Locator on its axis.
3. The blade of the Locator will be in line with the service when the signal strength indicator is at its minimum.

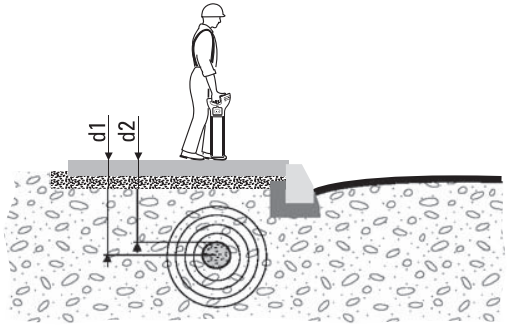
Depth Indication



1. Apply a signal to the service. Refer to "3 How to Use the Transmitter" for more information.
2. Select either 33kHz or 8kHz modes to suit the the Transmitter's output. Position the Locator directly over, and at 90degrees to the direction of the service.
3. Press and release the i Button.
4. The display readout will indicate the depth of the service and the Line mode icon will be displayed.

- Activating Sonde depth will provide an inaccurate readout.
- Always use chalk or paint to mark services, never pegs or other material which are driven into the ground.
- Additional services may be within the excavation zone, as well as the service you are taking a depth reading from.
- The reading will be more accurate when taken over a straight run, where the service does not bend, or have a service crossing it or coming off it.

Depth shown and actual depth:



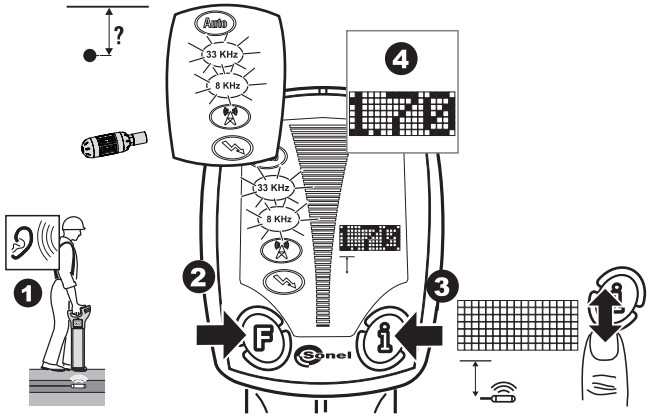
d1 Depth shown on the Sonel = depth to the centre of the line.
d2 Actual depth of the service.

Note the difference between d1 and d2 !

Warning

The depth reading might not reflect the real depth if your Locator picks up the signal induced into the service by the Transmitter. This signal is radiated from the centre of the service. This is even more important when the signal is produced by a Sonde, lying in a large diameter conduit!
Precautions:
Always compensate depth reading for service size.

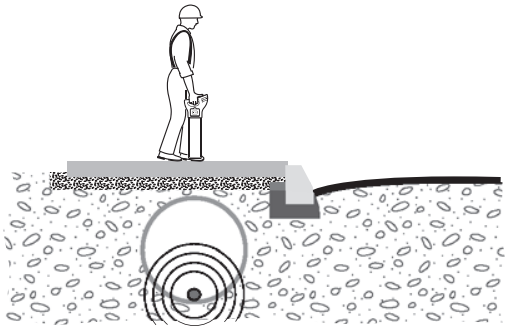
Measuring Sonde depth



1 Switch on the sonde and set to the required frequency. Refer to "7 How to Use the Sonde" for more information.
2. Select either 33kHz or 8kHz mode to suit the Sonde's output.Position the Locator directly over, and in line with the Sonde. Refer to "7 How to Use the Sonde" for more information.
3. Press and hold down the iButton for 2 seconds until the dashed lines have scrolled through once.
4. The display readout will indicate the depth of the Sonde and the Sonde mode icon will be displayed.

- Activating line depth will provide an inaccurate readout.
- Always use chalk or paint to mark services, never pegs or other material which are driven into the ground.
- Additional services may be within the excavation zone, as well as the service you are taking a depth reading from.

Depth shown and diameter:



Take special care when the signal is produced by a sonde, lying in a large diameter conduit!

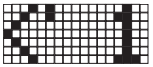
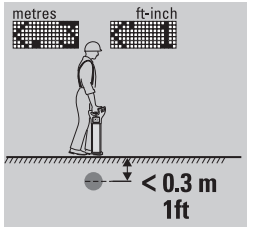
Warning

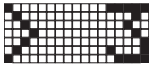
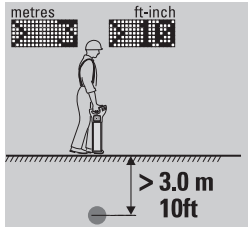
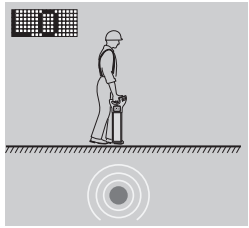
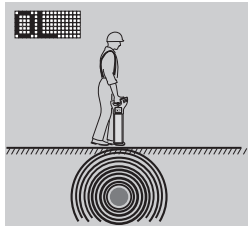
The depth reading may not indicate the real depth of the service, especially if the sonde is lying at the base of a large diameter duct.

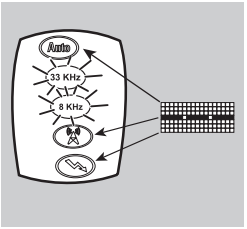
Precautions:

Always compensate depth reading for service size.

Depth code information

Information code	Description	Information on instrument label
metres  ft-inch	The service is too shallow to register properly.	

Information code	Description	Information on instrument label
 metres ft-inch	The service is too deep.	
	The signal received by the Locator is too small to register properly.	
	The signal received by the Locator is too large to register properly.	

Information code	Description	Information on instrument label
	Depth function not available. The Locator is set to the wrong mode for a depth reading to be taken.	

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3. How to Use the Transmitter LKN-1000

3.1 General Information

Tracing signal

The Transmitter applies an electrical current signal onto a buried metallic service, which enables the service to be traced and identified by the Locator operating in the same mode.

Operating mode

There are three operating modes for onsite flexibility:

- 8kHz for congested site operation • 33kHz for general usage
- Combined 8kHz and 33kHz available in Connection mode, enabling rapid selection and convenience on congested sites. The Locator can be used in either mode.

Description

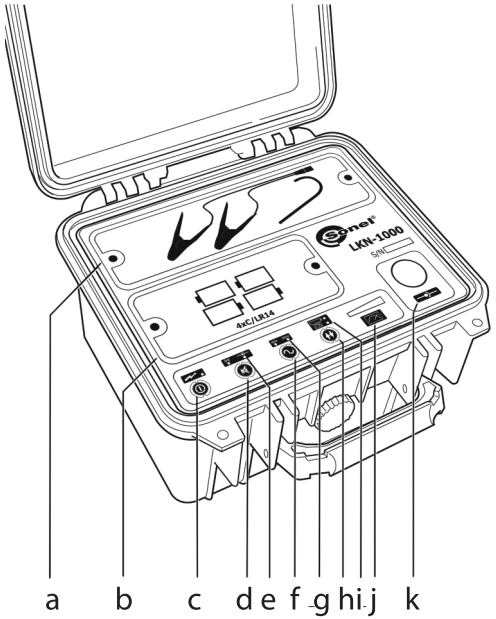
Active tracing is a term frequently used when a Transmitter is used to apply a signal to a service enabling it to be traced. The use of a Transmitter will greatly improve the detection of services especially ones which may not have a signal on them.
The signal from the Transmitter can be applied to services in two ways:

- Induction mode (8kHz or 33kHz):
  Induction is a quick and simple way to apply a signal to a service without the need to make any physical connection to it. The Transmitter uses an internal aerial to transmit the signal, therefore it should be noted that the signal will apply itself to additional services within close proximity to the Transmitter.
- Connection mode (8kHz or33 kHz or combinded 8kHz and 33kHz):
  This is the most efficient way of applying a signal to a service, and should be used whenever possible. The Transmitter's cable set or any of the available accessories are connected to the service which is to be traced or identified.

- 8kHz is less likely to apply itself to additional services making tracing in areas of multiple services easier.
- 33kHz is suitable for general site use.
- Combined 8 and 33kHz (Connection mode only) is useful in congested areas when either 8 or 33kHz may provide a better result. The best results can be simply achieved by switching modes on the Locator.

3.2 Transmitter Overview

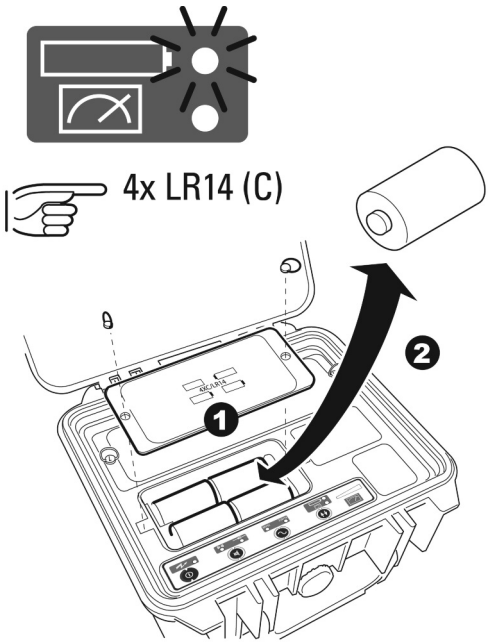
Transmitter LKN-1000 main parts



a Accessory Cover
b) Battery Cover
c) Power Control
Switches the unit on or off.
d) Mute Control
Used to silence the Transmitter.
e) Mode Display
Indicates which mode is selected: Induction or Connection.
f) Frequency Control Button
Used to select 8 kHz or 33 kHz output.
g) Frequency Display
Indicates which frequency is selected 8 kHz or 33 kHz.
h) Output Level Control
Used to vary the signal output of the Transmitter.
i) Battery Indicator
Flashes when the batteries need to be replaced. Replace all batteries when indicated.
j) Level Meter Display
Indicates the signal output level, and the condition of the batteries on initial start up.
k) Connection Socket
Used to connect accessories directly to metallic services. (Standard: crocodile clip cable set.)

Changing the battery

The battery indicator flashes when approximately 20% of battery life remains. The rate of flashing increases as the battery life declines.



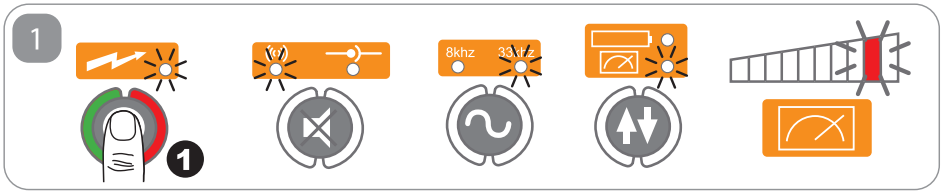
1. Loosen the two screws of the battery cover and remove them together with the cover.
2. Replace all batteries with four new LR14 (C) batteries.

Alkaline batteries should be used.

3.3 How to Locate a Service Using the Transmitter LKN-1000

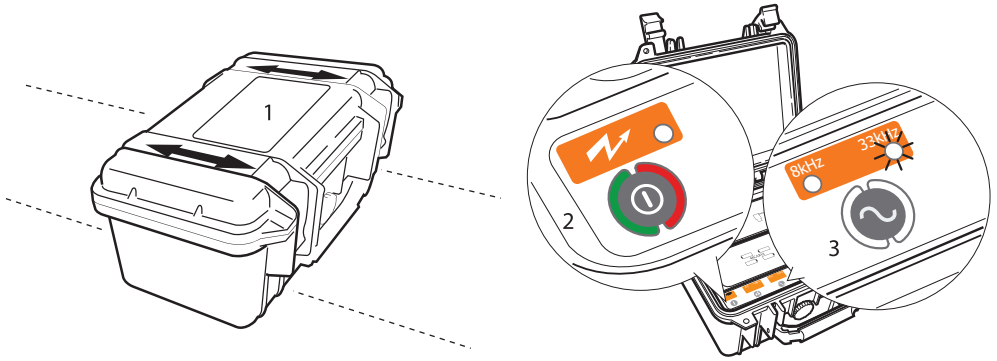
Start up test

The following test sequence will take place every time the Transmitter is activated.

On test	Test pattern
	
Audio output	On throughout test sequence.
LEDs	LEDs are all lit throughout the test sequence
Battery low indication	Battery level is shown throughout the test sequence, flashes if batteries are low.
Default mode selection	33kHz and maximum output level are automatically selected. Induction mode output is selected unless the transmitter's cable set or accessories are connected.

LKZ-1000 instrukcja EN 1_1a-bok_Layout 1 10-02-12 09:58 Strona 32

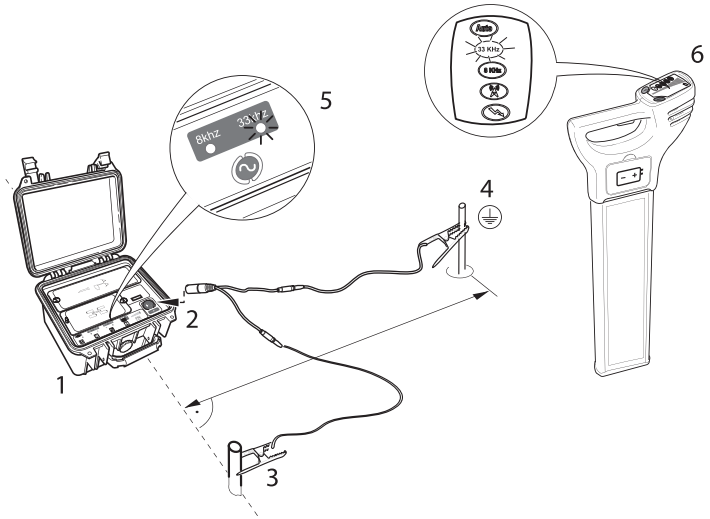
Using the Transmitter in Induction mode



1. Place the Transmitter over the service with the arrows on top of the case lid running in line with the suspected direction of the service.
2. Switch the Transmitter on and observe the battery level. Change batteries when indicated.
3. Select 8kHz or 33kHz mode, adjust output if required.The tracing signal is induced directly onto the service from the internal aerial.
4. Trace the path of the service using the Locator set to the same frequency. Refer to "2 How to Use the Locator" for more information.

- Work at least 10m / 33ft away from the Transmitter to avoid airborne signals. Reposition the Transmitter if required.
- Coupling efficiency is best at 33kHz.
- The signal will couple to adjacent services dependent on depth and direction.
- Reducing the signal output can help to increase the battery life and the Transmitter is less likely to apply a signal to an adjacent service.

Using the Transmitter in Induction mode



1. Switch the Transmitter on and observe the battery level. Change batteries when indicated.
2. Plug the Transmitter's cable set into the connection socket, the Transmitter will go into Connection mode as indicated on the mode display.
3. Connect the red cable to the service, a magnet is provided to assist on large services.
4. Connect the black cable to earth pin, ensuring that no services are below push the earth pin into the ground.A good level of tracing signal is indicated when the audible output changes from pulsed to continuous, and the signal level output goes to maximum.
5. Select 8kHz, 33kHz or combined 8 and 33kHz mode. Adjust output if required.
6. Trace the signal using the Locator set to the same operating mode. Refer to "2 How to Use the Locator" for more information.

Danger

Connecting the cable set to a live service can result in receiving an electric shock.
Precautions:
The connection cable set should never be connected directly to a live service.

- Ensure there are no services below the ground when using the earth pin. Use the Locator in advance.
- The black cable can be connected to other metallic structures which go into the ground.
- In dry conditions it may be necessary to add water around the earth point to get a good connection.
- Examine connection points and remove contamination if a continuous audible output is not achieved.
- An extension cable is available to extend the red or black cable sets.

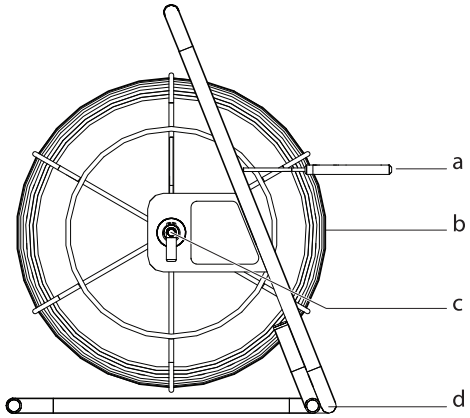
4. How to Use the Conductive Rods: 30meters (WAPRZPN30), 50meters (WAPRZPN50) or 80meters (WAPRZPN80)

4.1 General Information

Description

The Conductive Rod is a service tracer enabling small diameter non-conductive pipes or ducts to be traced. It can be used in Line mode or Sonde mode.

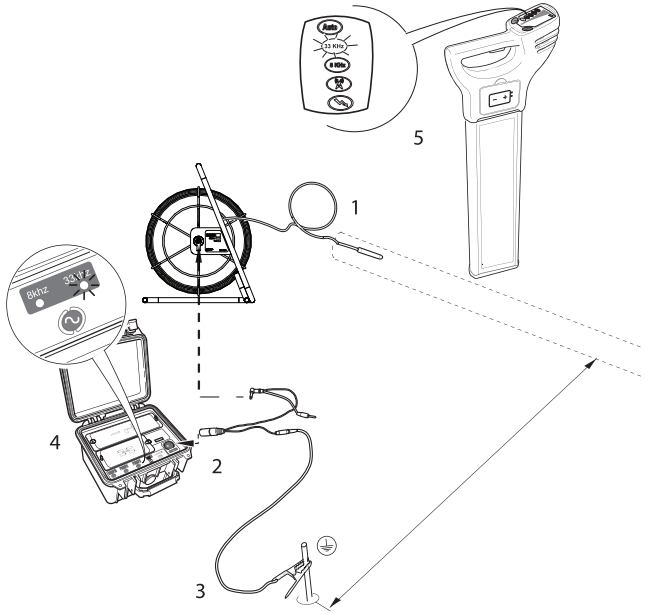
4.1 Conductive Rod Overview



a) End of Coil: Sonde mode
Used to accurately pinpoint the end point of the rod.
b) Rod: Line mode
Flexible, Glass Fibre sheathed, which incorporates copper wires to conduct the signal.
c) Signal connection socket
Used to connect to the Transmitter.
d) Frame
Houses the flexible rod. Can be used in both vertical (shown) and horizontal orientation.

4.3 How to Locate a Service Using the Conductive Rod

Using the Conductive Rod in Line mode



1. Insert the rod into the pipe, duct, conduit or drain until the desired length is in place.
2. Connect the Transmitter's cable set to the Transmitter socket and the rod socket in the middle of the frame.
3. Separate the black cable and connect the supplied crocodile clip cable, connect this to a suitable earth point.
4. Switch the Transmitter on and select 8kHz or 33kHz. A good signal is indicated when the audible output from the Transmitter is constant. The signal applies itself evenly along the length of the Conductive Rod.
5. Trace the length of the rod using the Locator set to the same frequency.

•Ensure there are no services below the ground when using the earth pin. Use the Locator in advance.
•At least half the Conductive Rod needs to be uncoiled when in use.

Using the Conductive Rod in Sonde mode

1. Insert the rod into the pipe, duct, conduit or drain until the desired length is in place.
2. Connect the cable set to the Transmitter socket and the rod socket in the middle of the frame. The black cable must be connected directly between Transmitter and Conductive Rod.
3. Switch the Transmitter on and select 8kHz or 33kHz. A good signal output is indicated when the audible output from the Transmitter is constant. The majority of the signal is concentrated towards the Sonde.
4. Trace the length of the rod using the Locator set to the same frequency.

•At least half the Conductive Rod needs to be uncoiled when in use.

5. How to Use the Signal Clamp N-2

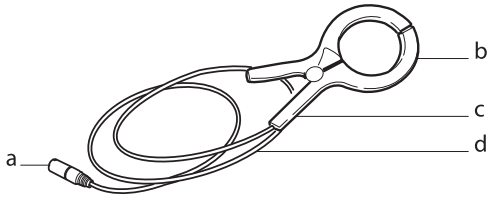
5.1 General Information

Description

The Signal Clamp N-2 provides a safe technique of applying a signal to services such as telecom cables, etc. It is connected to the Transmitter and then clipped around the service. Supply is not interrupted by the applied signal.

5.2 Signal Clamp N-2 Overview

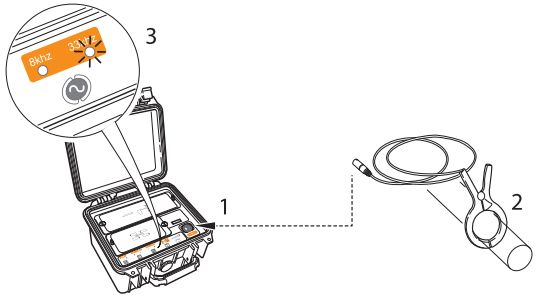
Signal Clamp main parts



a) Transmitter plug connector
b) Jaws
c) Handle
d) Cable

5.3 How to Locate a Service Using the Signal Clamp

Using the Signal Clamp



1. Connect the Signal Clamp to the Transmitter.
2. Open the jaws of the Signal Clamp and place around the service to be traced.
3. Switch the Transmitter on and select 33kHz. A good signal output is indicated when the audible output from the Transmitter is constant.
4. Trace the length of the service using the Locator set to the same frequency.

- Ensure the clamp jaws are fully engaged.
- Works best in 33kHz mode.

Danger

A hazardous signal may be present on the connection plug of the Signal Clamp when clipped over a live service.
Precautions:
The clamp should be connected to the Transmitter before clamping around a live service.

Danger

A hazardous signal may be present on the service causing personal harm.
Precautions:
Do not use on electrical services which have impaired, or no insulation. If in doubt do not use.

6. How to Use the Property Connection Set AS-1

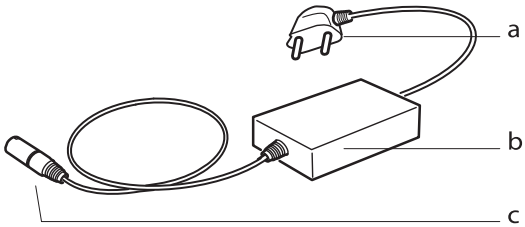
6.1 General Information

Description

The Property Connection Set provides a safe technique of applying a traceable signal to live electricity cables. It is connected to the service via a mains plug outlet and provides a traceable signal. Supply is not interrupted by the applied signal and the risk of serious injury is greatly reduced.

6.2 Property Connection Set Overview

Property Connection Set main parts



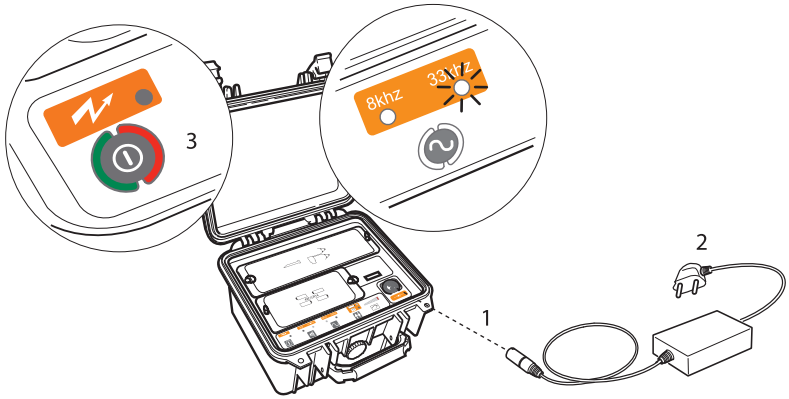
a) Mains plug connector
b) In line isolator
c) Transmitter plug connector

Available different plug connectors:

Europe („French”) standard	**WAADAAS1PL**
Switzerland standard	**WAADAAS1CH**
Australian standard	**WAADAAS1AU**
US standard	**WAADAAS1US**
UK standard	**WAADAAS1UK**

6.3 How to Locate a Service Using the Property Connection Set

Using the Property Connection Set



1. Connect the Property Connection Set to the Transmitter.
2. Connect the Property Connection Set to a live mains outlet. Ensure the switch on the mains is on.
3. Switch the Transmitter on and select 33kHz. A good signal output is indicated when the audible output from the Transmitter is constant.
4. Trace the length of the service using the Locator set to the same frequency.

- The mains supply must be live and switched on for correct operation.
- Works best with 33kHz.

Danger

A hazardous signal may be present on the connection plug of the Property Connection Set when connected to the mains supply.
Precautions:
The Property Connection Set should be connected to the Transmitter before connecting to the mains supply.

Danger

A hazardous signal may be present on the service or mains outlet causing personal harm.
Precautions:
Do not use on electrical services which have impaired, or no insulation. If in doubt do not use.

7. How to Use the Sonde NAD-1

7.1 General Information

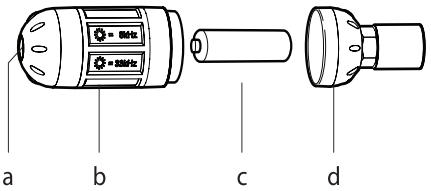
Description

The Sonde is a dual frequency signal transmitter used to trace drains, sewers and other non conductive services. It can be attached to a range of equipment including drain rods, boring tools and inspection cameras. It is powered by a 1.5V LR6 (AA) battery, so unlike other accessories this does not require a connection to the transmitter.The signal pattern transmitted from the Sonde is different to that which is radiated from a service; transmitting a peak signal over its main body, with a ghost signal at the front and back. This requires the Sonde to be traced with its own unique method.The i-Series Locators feature a numeric signal strength indicator (user setting SSI set to ON) which will greatly improve the locating process.

The numeric signal strength indicator is shown in the display readout on the Locator.

7.2 Sonde Overview

Sonde main parts

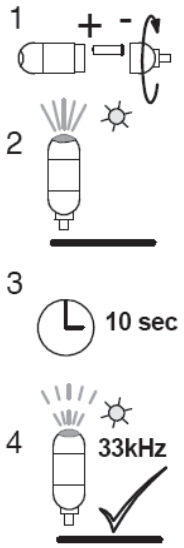


a) LED
b) Sonde body
c) LR6 (AA) battery
d) End cap and M10 connection point

The thread on the Sonde is a male M10, and comes with adaptors to both British and European drain rods.

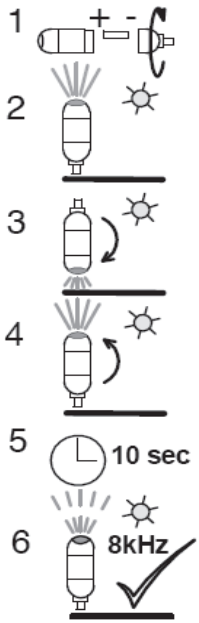
Changing the frequency output

Changing to 33kHz mode:



1. Unscrew and remove end cap. Insert battery, positive end first. Refit end cap securely.
2. Hold Sonde upright.Confirm green LED is continuous.
3. Wait approximately 10 seconds for the green LED to start flashing.
4. With the green LED flashing, the Sonde is ready for use at 33kHz.

Changing to 8kHz mode:

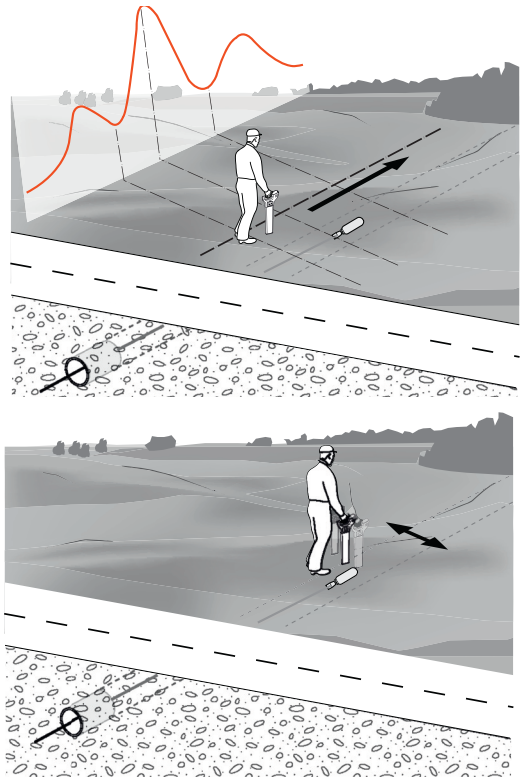


1. Unscrew and remove end cap.
   Insert battery, positive end first.
   Refit end cap securely.
2. Hold Sonde upright.
   Confirm green light is continuous.
3. Rotate Sonde so the LED points down and wait approximately 1second.
4. Rotate Sonde upright.Confirm the amber coloured LED is continuous.If LED remains green repeat from step 1.
5. Wait approximately 10 seconds for the amber LED to start flashing.
6. With the amber LED flashing, the Sonde is ready for use at 8kHz.

Once the function of the Sonde has been checked with a Locator set to the same operating mode it can be attached to drain rods or other means of guiding it into the service being traced.

7.3 How to Locate a Service Using the Sonde

Locating the Sonde



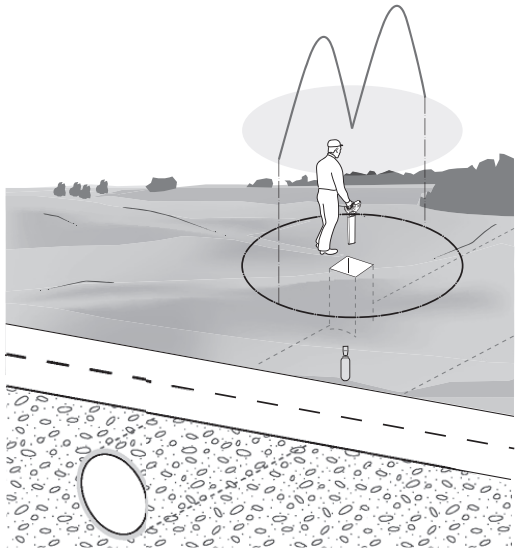
1. Walk in line with the suspected direction of travel observing the display. The signal strength indicator will rise and fall as you pass over the ghost signal at the back of the Sonde, the peak signal directly over the Sonde and the ghost signal at the front. The numeric signal strength indicator will display its highest value when detecting the peak signal.

2. Retrace your steps and position the locator directly over the peak signal. Move the locator left and right until the highest numeric reading is obtained. This reading will indicate the Sonde's precise location.

3. Depth indication
   Depth indication can be used with a suitable depth locator. The locator must be positioned directly over the Sonde and in line with it (rotate the locator on its axis to find the highest reading). Press and hold the i Button for 2seconds. The depth of the Sonde will be displayed in the depth readout window and the Sonde mode icon will be visible beneath the display.

- For ease and convenience mark the ground every 3 to 4 metres.
- For ease of use practice the process above ground

Tracing a “walk through” sewer



If a “walk through” sewer is being traced, another method is to place the Sonde vertically, for example to pinpoint a buried manhole. The Locator will pick up a pool of signal with a null point at the centre. This is an accurate method, but it is essential to ensure the Sonde is vertical.

8. Care and Transport

8.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you carry the product in its original transport container.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original Sonel packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

Shipping, transport of batteries

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

8.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "10 Technical Data" for information about temperature limits.

If the equipment is to be stored for a long time, remove the alkaline batteries from the product in order to avoid the danger of leakage.

8.3 Cleaning and Drying

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C / 104°F and clean them. Do not repack until everything is completely dry.

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

9. Technical Data

9.1 Locator LKO-1000 Technical Data

Typical detection range

Mode	Distance along conductor
Power Mode	length of conductor
Radio Mode	length of conductor
Conductive Rod Mode	length of unwound rod

Operating depth range

Mode	Range
Power Mode	to 3m / 10ft
Radio Mode	to 2m / 7ft
Transmitter Mode	to 3m / 10ft

Typical depth accuracy

10% of depth in line or Sonde
0.3 to 3.0m (1 to 10 ft) depth range

Operating frequencies

Mode	Frequency
Power Mode	50Hz or 60Hz
Radio Mode	15kHz to 60kHz
8kHz Mode	8.192 (8) kHz

Operating frequencies

Mode	Frequency
33kHz mode	32.768(33)kHz
Auto mode	Power mode and Radio mode

Display Panel

- 48 segment bar graph
- 5 mode indicators
- Battery status indicator
- Line depth indicator
- Sonde depth indicator
- Integrated backlight
- Annual service indicator
- 3 alpha numeric dot matrix displays 5x7

Keypad

2 membrane push buttons

Speakers

- Dual speakers:

Audio volumes: 85 dBA @ 30 cm

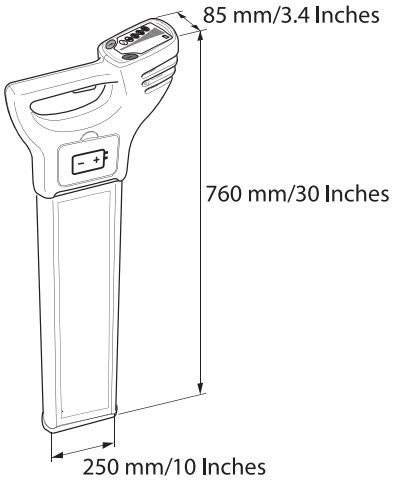
Tone: Power, Radio and Auto mode: continuous tone (different pitch for each tone).
8kHz and 33kHz mode: pulsed tone (different pitch for each tone). All five tones are different.

- Pneumatic headphone sockets are integrated

Internal battery

Type:	6 x LR6 (AA) alkaline
Typical operating time:	40hrs intermittent use at 20°C / 68°F; in 8kHz mode or 33kHzmode

Instrument dimensions



Weight

Instrument: (including batteries)	2.7kg / 6lbs

Environmental specifications

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	IP54 (IEC 60529) Dust-protected
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Locator LKO-1000 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Frequency band

50Hz to 60kHz

Output power

Receive only

9.2 Transmitter Technical Data LKN-1000

Typical detection range

Mode	Distance
Induction mode	150m / 490ft
Connection mode	250m / 820ft

Operating transmission frequencies

- 8.192(8)kHz or
- 32.768(33)kHz

Display panel

- 10 segment LED bar graph
- 4 LED mode indicators
- LED battery status indicator
- Led On/Off indicator
- LED signal output indicator

Keypad

4 membrane push buttons

Integral Speakers

Audio volumes: 51 dBA @ 30 cm

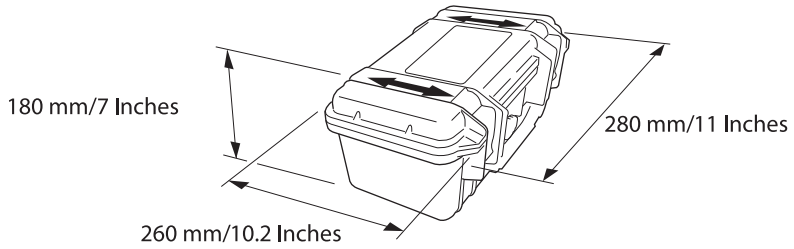
Tone:
- 8kHz mode: Low pitched tone
- 33kHz mode: Higher pitched tone
- Induction mode: Continuous tone
- Connection mode: Pulsed tone when poor or no current output, continuous tone when good connection

Internal battery

Type: 4 x LR14 (C) alkaline, supplied

Typical operating time: 40hrs intermittent use at 20°C / 68°F; in Connection mode

Instrument dimensions



Weight

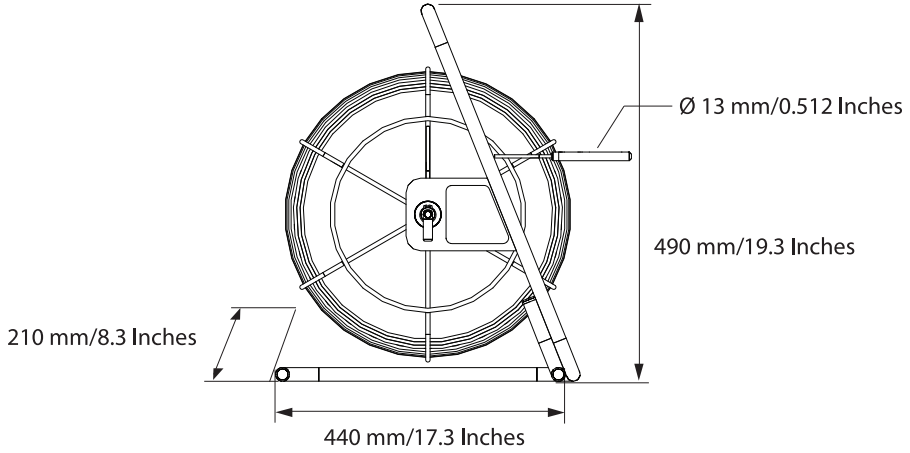
Instrument: (including batteries)	2.95kg / 6.5lbs

Environmental specifications

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection against Water, Dust and Sand	With cover open	IP54 (IEC 60529) Dust-protected
	With cover closed and secured	IP67 (IEC 60529) Dust tight Waterproof to 1m temporary immersion
Humidity		95% RH non condensing. The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations	• FCC Part 15 (applicable in US) • Hereby, Sonel S.A. declares that the transmitter LKN-1000 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state. • The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
Frequency band	8kHz to 33kHz
Output power	100mW maximum, when directly connected to a buried service with a ground impedance of 100 Ohm or less.

9.3 Conductive Rods Technical Data

Typical detection range	Both modes, Line and Sonde: Typical 3.0m / 10ft
Tracing distance	max: 30m/99ft (WAPRZPN30); 50m/165ft (WAPRZPN50); 80m/263ft (WAPRZPN80). Reel length dependant
Operating transmission frequencies	• 8.192(8)kHz or • 32.768(33)kHz
Instrument dimensions	
Weight	Instrument: 7.3kg / 16.1lbs

Environmental specifications

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection against Water, Dust and Sand	Frame	IP54 (IEC 60529)Dust-protected
	Rod	Fully submersible
Humidity		95% RH non condensingThe effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Conductive Rod is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
  Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

9.4 Sonde NAD-1 Technical Data

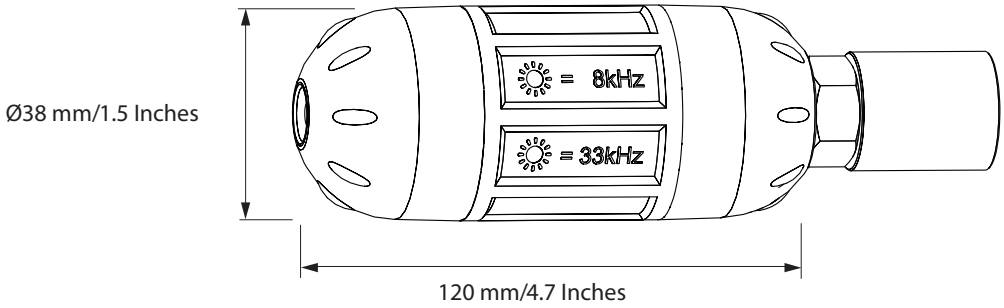
Operating transmission frequencies

- 8.192(8)kHz or
- 32.768(33)kHz

Type: 1 x LR6 (AA) alkaline

Typical operating time: 40 hrs intermittent use at 20°C / 68°F; in 8 kHz mode or 33 kHz mode

Instrument dimensions



Weight

Instrument: (including batteries) 0.18 kg / 0.4 lbs

Environmental specifications

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	Fully submersible
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

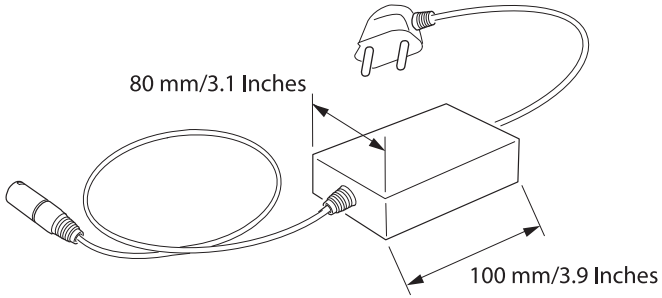
- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Sonde is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

9.5 Property Connection Set AS-1 Technical Data

Operating transmission frequencies

- 8.192(8)kHz or
- 32.768(33)kHz

Instrument dimensions



Weight

Instrument: 0.15 kg / 0.3 lbs

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	IP54 (IEC 60529)Dust-protected
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Property Copnnection Set is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Available different plug connectors:

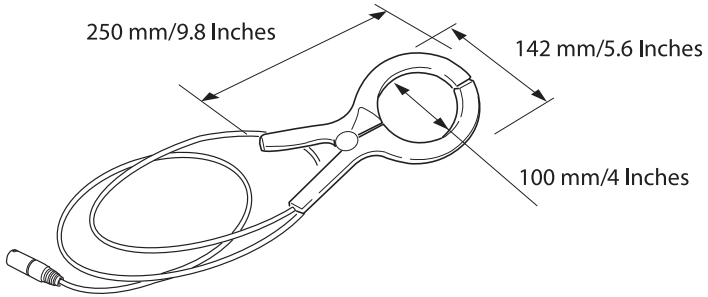
Europe („French") standard	**WAADAAS1PL**
Switzerland standard	**WAADAAS1CH**
Australian standard	**WAADAAS1AU**
US standard	**WAADAAS1US**
UK standard	**WAADAAS1UK**

9.6 Signal Clamp N-2 Technical Data

Operating transmission frequencies

32.768(33)kHz
when used with a signal transmitter set in 33kHz mode.

Instrument dimensions



Weight

Instrument: 0.354kg / 0.76lbs

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	IP54 (IEC 60529)Dust-protected
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Signal Clamp N-2 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
  Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

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Appendix A

A.1

Checking the Function

Functional Checks

Locator Functional Check

Before any tests can be carried out it is vital to check the status of the unit, its batteries and basic functionality.
The following list is used to achieve this.

1.Inspection

• Casing	The casing should be free of significant damage.
• Labels	Body labels must be legible and intact. Display label must be free of damage and tears.
• Battery hatch	The hatch must lock into place.
• Battery holder	All the battery contacts and springs on the holder must be free of corrosion and the holder in good condition.
• Battery contacts	The battery contacts must be free of corrosion.

Once the general condition of the Locator is established the Audio Visual test can be performed.

2.Audio / Visual display test
Upon depressing the trigger the Locator should test the display and speakers by illuminating each segment in the bar display, the mode and function indicators and depth display, the battery indicator light will illuminate throughout the display test. All LCDs must be operative and an audible output must be heard.

3.Battery / Functional self check
If there is no response when the trigger is activated or the low battery illuminates (or flashes) after the Audio / Visual display test, the batteries will have to be replaced. Use alkaline batteries. Replace all of the batteries at the same time.

Checking the Performance

The purpose of the following procedure is to verify the performance of the Locator. It is important that the test is conducted away from areas of electromagnetic interference or over buried services with a large signal radiating off them.

1. Switch the Locator on.
2. Whilst in Power mode hold down the i Button, until the settings are displayed.
3. Using the Function Button toggle through the settings until EST is displayed.
4. Press the i Button to activate the test.
5. Observe the displayed output:
   PAS means unit is within set tolerances.
   ERR means unit is outside set tolerances and may need servicing

- Repeat the test in a different location if the units displays ERR.
- The Locator will automatically repeat the function test if it fails.
- Repeated failure will indicate a faulty unit, which must be returned for service.

Checking depth indication

This test can be carried out provided the depth of a service on the test area is known.

1. Switch the Locator on and ensure that it is in 33kHz mode.
2. Position the Locator directly over and at right angle to the service.
3. Press and release the i Button to activate the depth measurement.
4. Record the depth.
5. If the depth reading deviates from the normal value or an error code is displayed, the Locator should be returned for service.

If any of these tests give no response or a significantly different response from normal, the Locator should be returned for service.

Functional test check list

Functional test check list					
Unit: Locator...	Serial Number:			Comments:	
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Casing				Return for repair/ Replace	Casing should be free of damage.
2. Labels				Return for repair/ Replace	Body labels must be legible and intact. Display label must be free of damage and tears.
3. Battery hatch				Return for repair/ Replace	Hatches must be free of corrosion.
4. Battery holder				Replace	Holder must be free of corrosion.
5. Battery contacts				Return for repair	Contacts must be free of corrosion.
6. Audio/Visual display test				Return for repair	LCD is illuminated and an audible output must be heard.

Functional test check list					
7. Batteries				Replace	Replace alkaline batteries if pack is exhausted (no response) or if the battery indicator light is illuminated or flashing after display test. Replace all batteries!
8. Power mode				Return for repair	Response width and peak value similar to test unit.
9. Radio mode				Return for repair	Response width and peak value similar to test unit.
10. 8 kHz				Return for repair	Response width and peak value similar to test unit.
11. 33 kHz				Return for repair	Response width and peak value similar to test unit.
12. Depth Mode 8kHz and 33kHz				Return for repair	Gives same result as test unit (10% accuracy).
Tested by:					Date:

A.2 Transmitter Functional Check

Checking the Function

The purpose of the following procedure is to verify the performance of the Signal Transmitter.

Before any tests can be carried out it is vital to check the status of the unit, its batteries and basic functionality.

To carry out this test the following are required:
- A Locator to detect the signals.
- A test area free of services as illustrated.

1.Inspection

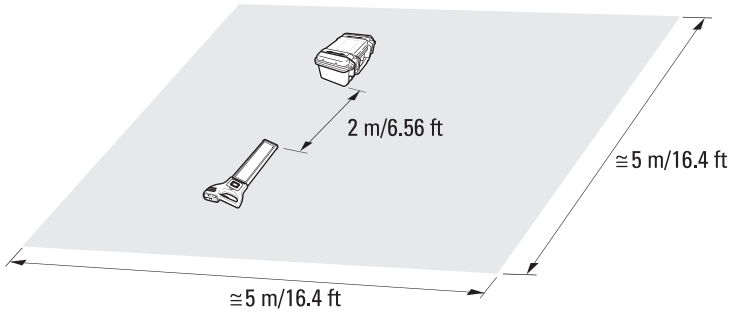
• Casing	The casing should be free of significant damage.
• Labels	Body labels must be legible and intact. Display label must be free of damage and tears.
• Battery hatch	The hatch must lock into place.
• Battery holder	All the battery contacts and springs on the holder must be free of corrosion and the holder in good condition.
• Battery contacts	The battery contacts must be free of corrosion.

Once the general condition of the Transmitter is established the Audio Visual test can be performed.

2.Audio / Visual display test
Turn on the Transmitter. The LED display will illuminate and the speakers will emit a tone, the battery/output level indicator will illuminate throughout the test. All LEDs must be operative and an audible output must be heard.

3. Battery check
Battery status is momentarily indicated after the Audio / Visual display test. The battery level indicator will indicate the condition of the battery. When the batteries need replacing the battery indicator will flash. Use alkaline batteries. Replace all of the batteries at the same time.

4. Inductive mode check
Turn on the Transmitter and Locator both set to 33kHz mode. At a distance of 2m/6.56ft, the Locator should detect and indicate with both the audio and visual indicators.Change the Transmitter and Locator modes to 8kHz and repeat. The speed of the audio pulsed output of both Transmitter and Locator should slow down.



5. Output signal level check
Press the output level control button, the indicated power should reduce to minimum and then increase with repeated presses until the maximum level is again reached.

6. Connection mode check

With the Transmitter operating in the 33kHz Induction mode, plug in the transmitter's cable set. The pulsing audio tone should change and the connection/induction LED change to indicate that the output has automatically changed over to the connection mode.Connect the transmitter's cable set together, the output audio tone should change from pulsed to continuous and the Level meter display should read maximum.

Turn on the Locator set to 33kHz mode and place it over one of the output connection cables.

The Locator should detect and indicate with both audio and visual indicators.Change the Transmitter and Locator modes to 8kHz and repeat. The speed of the audio pulsed output of the Transmitter should slow down.

If any of these tests give no response or a significantly different response from normal, the Transmitter should be returned for service.

Functional test check list

Functional test check list					
Unit: Transmitter...	Serial Number:			Comments:	
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Casing				Return for repair/ Replace	Casing should be free of damage.
2. Labels				Return for repair/ Replace	Body labels must be legible and intact. Display label must be free of damage and tears.
3. Battery cover and accessory cover				Return for repair/ Replace	Hatches must lock into place.
4. Battery contacts				Replace	Contacts must be free of corrosion.
5. Audio/Visual display test				Return for repair	All LEDs must illuminate and an audible output must be heard.
6. Batteries				Return for repair	Replace alkaline batteries if exhausted (no response) or if the battery indicator light is illuminated or flashing after display test. Replace all batteries!

Functional test check list					
7. Induction mode				Return for repair / Replace	Reduced or no output signal.
8. Connection mode; no change in audio indication				Return for repair / Replace	Faulty cable.
9. Connection mode; no change in audio indication				Return for repair / Replace	No output signal.
Tested by:					Date:

A.3 Conductive Rod Functional Check

Checking the Function

The purpose of the following procedure is to verify the performance of the Conductive Rod.

To carry out this test the following are required:
- A Transmitter for generating the signal in the Sonde and Line mode tests
- The cable set for the Conductive Rod.

Insert the Conductive Rod's cable set into the Transmitter and Conductive Rod. Ensure the black cable is connected. Switch the Transmitter on. The audible output from the Transmitter must be constant. Adjust the signal output on the Transmitter to minimum, the audible output must be constant. Part the black cable set in the middle, the audible output must be pulsed.

If any of these tests give no response or a significantly different response from normal, the Conductive Rod should be returned for service.

Functional test check list

Functional test check list					
Unit: Conductive Rod...	Serial Number:			Comments:	
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Sonde mode: Transmitter audio output does not go continuous				Return or replace cable set	Faulty cable.
2. Sonde mode: Locator does not detect signal				Return for repair/ Replace	One or both internal wires are open or short circuit.
3. Line mode: Locator does not detect signal				Return for repair/ Replace	One or both internal wires are open or short circuit.
Tested by:					Date:

A.4 Sonde Functional Check

Checking the Function

The purpose of the following procedure is to enable a user to verify the performance of the Sonde.

To carry out this test the following are required:

- A Locator to detect the signal.
- A work area free of services as illustrated.

1.Inspection

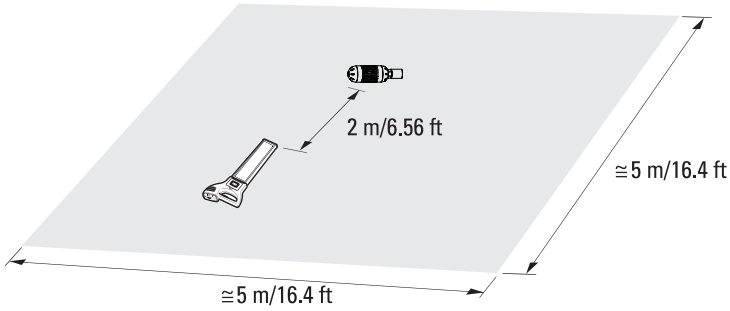
- Casing — The casing should be free of significant damage, with the sealing ring and the screw thread intact

Once the general condition of the Sonde is established the self test can then be used to indicate the basic unit function and state of the batteries.

2. LED test
Turn on the sonde, the led display will illuminate.

3. Battery check
A dull LED, and lack of detection range will indicate poor battery condition. Use alkaline batteries.

1. Switch sonde on and activate 33kHz mode.
2. Set Locator to 33kHz mode and aim at Sonde (see diagram).
3. At 2m/6.56ft the Locator must be at maximum.
4. Repeat this with Sonde and Locator in 8kHz.



If any of these tests give no response or a significantly different response from normal, the Sonde should be returned for service.

Functional test check list

Functional test check list					
Unit: Conductive Rod...	Serial Number:			Comments:	
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Casing				Fail	Casing should be free of damage.
2. Screw thread and seal				Fail	Screw thread must be intact and seal in place.
3. Battery contacts				Fail	Contacts must be free of corrosion.maximum display at 2metres.
4. 33 kHz mode				Fail	LED must be illuminated brightly and pulse fast. Locator must provide maximum display at 2 metres.
5. 8 kHz mode				Fail	LED must be illuminated brightly and pulse slowly. Locator must provide maximum display at 2metres.
Tested by:					Date:

Appendix B World Frequency Zones

North America	
Canada	120 V / 60 Hz
United States	120 V / 60 Hz
Mexico	120 V / 50 Hz, 60 Hz
Central America	
Bahamas	115 V / 60 Hz
Barbados	115 V / 50 Hz
Belize	110-220 V / 60 Hz
Bermuda	115 V / 60 Hz
Costa Rica	120 V / 60 Hz
Cuba	115-120 V / 60 Hz
Dominican Republic	110-220 V / 60 Hz
El Salvador	120-240 V / 60 Hz
Guatemala	115-230 V / 60 Hz
Haiti	110-220 V / 60 Hz
Honduras	110-220 V / 60 Hz
Jamaica	220 V / 50 Hz
Netherland Antilles	110-127 V / 50 Hz
Nicaragua	120 V / 60 Hz
Panama	120 V / 60 Hz
Puerto Rico	120 V / 60 Hz
Trinidad & Tobago	115-230 V / 60 Hz
Virgin Islands	120 V / 60 Hz

South America	
Argentina	230 V / 50 Hz
Bolivia	110 V / 50 Hz
Brazil	110-127-220 V / 60 Hz
Chile	220 V / 50 Hz
Colombia	110-220 V / 60 Hz
Ecuador	110-220 V / 60 Hz
French Guiana	220 V / 50 Hz
Guyana	110-240 V / 60 Hz
Paraguay	220 V / 60 Hz
Peru	220 V / 60 Hz
Surinam	110-127 V / 60 Hz
Uruguay	220 V / 50 Hz
Venezuela	120-240 V / 60 Hz
Australia, Oceania	
Australia	240 V / 50 Hz
Fiji Islands	240 V / 50 Hz
New Zealand	230 V / 50 Hz
Solomon Island	240 V / 50 Hz
Tonga	230 V / 50 Hz

Europe	
Albania	230 V / 50 Hz
Austria	230 V / 50 Hz
Belgium	230 V / 50 Hz
Belarus	230 V / 50 Hz
Bulgaria	230 V / 50 Hz
Croatia	230 V / 50 Hz
Czech Republic	230 V / 50 Hz
Denmark	230 V / 50 Hz
Estonia	230 V / 50 Hz
Finland	230 V / 50 Hz
France	230 V / 50 Hz
Germany	230 V / 50 Hz
Greece	230 V / 50 Hz
Hungary	230 V / 50 Hz
Iceland	230 V / 50 Hz
Ireland	230 V / 50 Hz
Italy	230 V / 50 Hz
Latvia	230 V / 50 Hz
Lithuania	230 V / 50 Hz
Luxemburg	230 V / 50 Hz
Moldavia	230 V / 50 Hz
Netherlands	230 V / 50 Hz
Norway	230 V / 50 Hz
Poland	230 V / 50 Hz
Portugal	230 V / 50 Hz
Romania	230 V / 50 Hz
Russia	230 V / 50 Hz
Slovakia	230 V / 50 Hz
Slovenia	230 V / 50 Hz
Spain	230 V / 50 Hz
Sweden	230 V / 50 Hz
Switzerland	230 V / 50 Hz
Ukraine	230 V / 50 Hz
United Kingdom	230 V / 50 Hz
Yugoslavia	230 V / 50 Hz

Africa	
Algeria	127-220 V / 50 Hz
Angola	220 V / 50 Hz
Benin	220 V / 50 Hz
Botswana	220 V / 50 Hz
Burkina Faso	220 V / 50 Hz
Burundi	220 V / 50 Hz
Cameroon	127-220 V / 50 Hz
Central Africa Rep.	220 V / 50 Hz
Chad	220 V / 50 Hz
Congo	220 V / 50 Hz
Dahomey	220 V / 50 Hz
Egypt	220 V / 50 Hz
Ethiopia	220 V / 50 Hz
Gabon	220 V / 50 Hz
Gambia	230 V / 50 Hz
Ghana	240 V / 50 Hz
Ivory Coast	220 V / 50 Hz
Kenya	240 V / 50 Hz
Lesotho	220-240 V / 50 Hz
Liberia	120 V / 60 Hz
Libya	115-220 V / 50 Hz
Malawi	230 V / 50 Hz
Mali	220 V / 50 Hz
Mauritania	220 V / 50 Hz
Mauritius	230 V / 50 Hz
Morocco	127-220 V / 50 Hz
Mozambique	220 V / 50 Hz
Namibia	220 V / 50 Hz
Niger	220 V / 50 Hz
Nigeria	230 V / 50 Hz
Rwanda	220 V / 50 Hz
Senegal	110 V / 50 Hz
Sierra Leone	230 V / 50 Hz
Somalia	220 V / 50 Hz
South Africa	220-240 V / 50 Hz
Sudan	240 V / 50 Hz
Swaziland	220 V / 50 Hz
Tanzania	230 V / 50 Hz
Togo	127-220 V / 50 Hz
Tunisia	127-220 V / 50 Hz
Uganda	240 V / 50 Hz
Zaire	220 V / 50 Hz
Zambia	220 V / 50 Hz
Zimbabwe	220 V / 50 Hz

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Asia	
Abu Dhabi	230 V / 50 Hz
Afghanistan	220 V / 50 Hz
Armenia	220 V / 50 Hz
Azerbaijan	220 V / 50 Hz
Bahrain	110-230 V / 50 Hz, 60 Hz
Bangladesh	230 V / 50 Hz
Brunei	240 V / 50 Hz
Cambodia	220 V / 50 Hz
China	220 V / 50 Hz
Cyprus	240 V / 50 Hz
Georgia	220 V / 50 Hz
Hong Kong	220 V / 50 Hz
India	230-250 V / 50 Hz, 60 Hz
Indonesia	127-220 V / 50 Hz
Iran	220 V / 50 Hz
Iraq	220 V / 50 Hz
Israel	230 V / 50 Hz
Japan	100-220 V / 50 Hz, 60 Hz
Jordan	220 V / 50 Hz
Kazakhstan	220 V / 50 Hz
Kirgizstan	220 V / 50 Hz
Korea (North)	220 V / 50 Hz
Korea (South)	110-220 V / 60 Hz
Kuwait	240 V / 50 Hz
Laos	220 V / 50 Hz
Lebanon	110-220 V / 50 Hz
Malaysia	240 V / 50 Hz
Myanmar	240 V / 50 Hz
Oman	240 V / 50 Hz
Pakistan	230 V / 50 Hz
Philippines	110-220 V / 60 Hz
Qatar	240 V / 50 Hz
Saudi Arabia	127-220 V / 50 Hz
Singapore	230 V / 50 Hz
Sri Lanka	230 V / 50 Hz
Syria	220 V / 50 Hz
Taiwan	110-220 V / 60 Hz
Tajikistan	220 V / 50 Hz
Thailand	220 V / 50 Hz
Turkey	220 V / 50 Hz
Turkmenistan	220 V / 50 Hz
United Arab Emirates	220 V / 50 Hz
Uzbekistan	220 V / 50 Hz
Vietnam	120-220 V / 50 Hz
Yemen	220 V / 50 Hz

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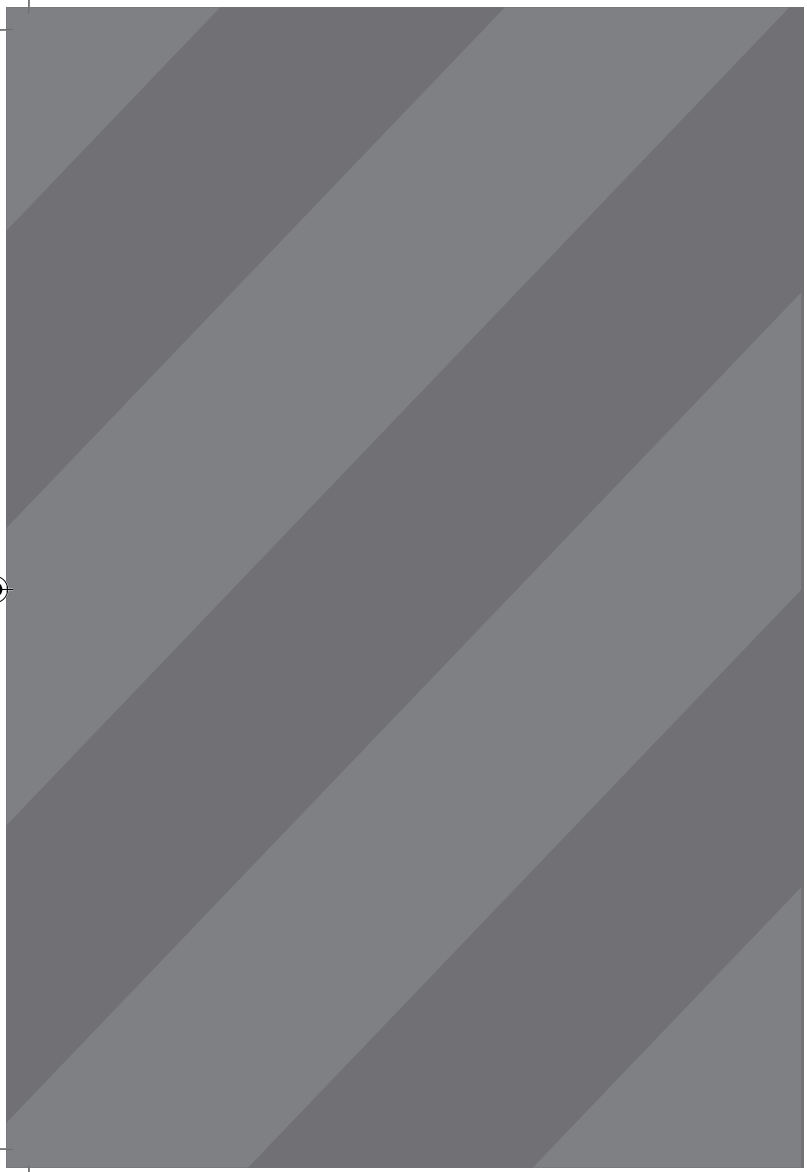

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